

Application Number: 09/830,894
Amendment Dated: July 7, 2005
Reply to Office Action Dated: April 7, 2005

Listing of the Claims:

1. (currently amended) A process for the production of a biological product by a microorganism comprising the steps of:
 - providing a microorganism that produces the biological product, and uses oxygen and an alternative oxidant source other than oxygen for cellular respiration;
 - providing a culture medium suitable for the growth of the microorganism, wherein the medium comprises at least one carbon source;
 - inoculating the culture medium with a desired cellular concentration of the microorganism;
 - aerating the culture medium with oxygen, wherein the process has a maximum oxygen replenishment rate to the culture medium, ~~wherein the maximum oxygen replenishment rate is defined as the maximum rate of oxygen mass transfer to the medium at any given dissolved oxygen concentration of the culture medium and any given oxygen partial pressure over the culture medium;~~
 - supplying the culture medium with a suitable amount of the alternative oxidant source that can be used by the selected microorganism to permit cellular respiration such that when the oxygen requirement for cellular respiration of the microorganism within the culture medium is less than the maximum rate of oxygen replenishment to the culture medium, the microorganisms will substantially utilize oxygen for cellular respiration, and when the oxygen requirements for cellular respiration of the microorganisms within the culture medium is greater than the maximum rate of oxygen supply to the culture medium, then at least a portion of the microorganism concentration within the culture medium will utilize the alternative oxidant source for cellular respiration;
 - sustaining cells in the culture medium such that at least a portion of the population consumes said the alternative oxidant during at least a part portion of the production process;

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maintaining the culture medium at a suitable pH and temperature for the selected microorganism; and

allowing the culture medium to incubate, thereby yielding a biological product;
and

recovering the biological product.

2. (currently amended) The process of claim 1, wherein the step of recovering the biological product further comprising comprises the steps step of isolating and recovering said the biological product from said the culture media medium.

3. (original) The process of claim 1, wherein the microorganism is selected from the group consisting of bacteria, yeasts, molds and archaea.

4. (original) The process of claim 3, wherein the microorganism is a bacteria.

Claim 5 (canceled).

6. (previously presented) The process of claim 4, wherein the bacteria is selected from a genus selected from the group consisting of *Pseudomonas*, *Paracoccus*, *Micrococcus*, *Klebsiella*, *Escherichia*, *Acidianus*, *Campylobacter*, *Wolinella*, and *Proteus*.

7. (original) The process of claim 6, wherein the genus is *Pseudomonas*.

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8. (original) The process of claim 7, wherein the species of the genus *Pseudomonas* is selected from the group consisting of *Pseudomonas aeruginosa*, *Pseudomonas fluorescens*, *Pseudomonas putida*, *Pseudomonas cruciviae*, *Pseudomonas boreopolis* and *Pseudomonas oleovorans*.

9. (original) The process of claim 8, wherein the species of *Pseudomonas* is *Pseudomonas aeruginosa*.

10. (currently amended) The process of claim 1, wherein the at least one carbon substrate source is selected from the group consisting of fatty acids, glycerol, low molecular weight acids, carbohydrates, yeast extract, peptone and vegetable oil.

11. (original) The process of claim 10, wherein the fatty acids are selected from the group consisting of palmitic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, butyric acid, caproic acid, lauric acid, and linolenic acid.

12. (original) The process of claim 11, wherein the fatty acid is palmitic acid.

13. (original) The process of claim 10, wherein the vegetable oil is selected from the group consisting of corn oil, peanut oil, coconut oil, linseed oil, olive oil, soy bean oil and sunflower oil.

14. (original) The process of claim 13, wherein the vegetable oil is corn oil.

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15. (original) The process of claim 10, wherein the carbohydrate is glucose.

16. (original) The process of claim 10, wherein the low molecular weight acid is selected from the group consisting of malate, acetate and pyruvate.

17. (original) The process of claim 1, wherein the alternative oxidant source is selected from the group consisting of nitrates, nitrites, sulfates, sulfites, carbonates, fumarates, sulfur, manganic ion, ferric ion, selenate, dimethyl sulfoxide, arsenate, trimethylamine N-oxide and glycine.

18. (original) The process of claim 17, wherein the alternative oxidant source is a nitrate.

19. (original) The process of claim 18, wherein the nitrate is selected from the group consisting of sodium nitrate, potassium nitrate, calcium nitrate, magnesium nitrate, ammonium nitrate, and nitric acid.

20. (original) The process of claim 19, wherein the nitrate is sodium nitrate.

21. (original) The process of claim 17, wherein the nitrites are selected from the group consisting of sodium nitrite, potassium nitrite, calcium nitrite, ammonium nitrite, and nitrous acid.

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22. (original) The process of claim 17, wherein the sulfates are selected from the group consisting of sodium sulfate, potassium sulfate, calcium sulfate, iron sulfate, magnesium sulfate, ammonium sulfate, zinc sulfate, copper sulfate, cobalt sulfate, manganese sulfate, and dilute sulfuric acid.

23. (original) The process of claim 17, wherein the sulfites are selected from the group consisting of calcium sulfite, sodium sulfite, potassium sulfite, iron sulfite, magnesium sulfite, ammonium sulfite, zinc sulfite, copper sulfite, cobalt sulfite and manganese sulfite.

24. (original) The process of claim 17, wherein the carbonates are selected from the group consisting of calcium carbonate, sodium carbonate, and potassium carbonate.

25. (original) The process of claim 17, wherein the bicarbonates are selected from the group consisting of calcium bicarbonate, sodium bicarbonate, and potassium bicarbonate.

26. (original) The process of claim 17, wherein the fumarates are selected from the group consisting of disodium fumarate, sodium fumarate, dipotassium fumarate, potassium fumarate, and fumaric acid.

27. (currently amended) The process of claim 1, further comprising the step of adding a sufficient amount of a surfactant to said the culture medium to facilitate the mass transfer of said the carbon substrate source into said the culture medium.

28. (original) The process of claim 1, further comprising the step of limiting an essential growth nutrient from the culture medium.

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29. (original) The process of claim 28, wherein the essential growth nutrient is selected from the group consisting of phosphorous, nitrogen, sulfur, calcium, magnesium and iron.

30. (original) The process of claim 29, wherein the essential growth nutrient is phosphorous.

31. (currently amended) The process of claim 1, wherein said the cellular concentration of said the microorganism is from about 0.1 g/L to about 50 g/L.

32. (original) The process of claim 1, wherein the concentration of the alternative oxidant source in the culture medium is in the range of from about 0.01 to about 10 g/L.

33. (original) The process of claim 1, wherein the culture is maintained in a temperature range of about 20⁰C to about 40⁰C.

34. (original) The process of claim 1, wherein the culture is maintained in a pH range of about 4 to about 9.

Claims 35 through 69 (cancelled).

70. (currently amended) A process for increasing concentration of a microorganism in a medium comprising the steps of:

providing a microorganism having the ability to produce a biological product, the microorganism being capable of utilizing oxygen and an alternative oxidant source other than oxygen for cellular respiration;

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providing a culture medium suitable for the growth of the microorganism, wherein the medium comprises at least one carbon source;

inoculating the culture medium with a desired cellular concentration of the microorganism;

aerating the culture medium with oxygen, wherein the process has a maximum oxygen replenishment rate to the culture medium;

supplying the culture medium with a suitable amount of the alternative oxidant source that can be used by the microorganism, such that when the oxygen requirements for cellular respiration of the microorganism within the culture medium is less than the maximum rate of oxygen supply to the culture medium, then the microorganism will substantially utilize oxygen for cellular respiration, and when the oxygen requirements for cellular respiration of the microorganism within the culture medium is greater than the maximum rate of oxygen supply to the culture medium, then at least a portion of the microorganism concentration within the culture medium will utilize the alternative oxidant source for cellular respiration;

maintaining the culture medium at a desired pH and temperature; and

allowing the culture medium to incubate, thereby yielding an increased concentration of the microorganism in the culture medium; and

recovering the microorganism from the culture medium.

Claims 71 through 104 (cancelled).

105. (new) The process of claim 1, wherein the biological product is at least one biological product selected from biosurfactants, biopolymers, proteins, and enzymes.

106. (new) The process of claim 1, wherein the biological product is at least one biosurfactant.

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107. (new) The process of claim 106, wherein the at least one biosurfactant is selected from one or more rhamnolipids, sophorolipids, trehalose mycolates, trehalose esters, monosaccharide mycolates, disaccharide mycolates, trisaccharide mycolates, phospholipids, fatty acids, gramicidens, polymyxins, ornithinelipids, cerilipin, lysine-lipids, surfactins, subtilisin, peptide-lipids, heteropolysaccharides, liphoheteropolysaccharides, poly-saccharide-proteins, manno-proteins, carbohydrate-proteins, mannan-lipid complexes, mannose/erythrose-lipids, carbohydrate-protein-lipid complexes, and fimbriae.

108. (new) The process of claim 1, wherein the biological product is at least one rhamnolipid.

109. (new) The process of claim 70, wherein the microorganism has the ability to produce at least one biosurfactant, biopolymer, protein, or enzyme.

110. (new) The process of claim 70, wherein the microorganism has the ability to produce at least one at least one biosurfactant.

111. (new) The process of claim 110, wherein the at least one biosurfactant is selected from one or more rhamnolipids, sophorolipids, trehalose mycolates, trehalose esters, monosaccharide mycolates, disaccharide mycolates, trisaccharide mycolates, phospholipids, fatty acids, gramicidens, polymyxins, ornithinelipids, cerilipin, lysine-lipids, surfactins, subtilisin, peptide-lipids, heteropolysaccharides, liphoheteropolysaccharides, poly-saccharide-proteins, manno-proteins, carbohydrate-proteins, mannan-lipid complexes, mannose/erythrose-lipids, carbohydrate-protein-lipid complexes, and fimbriae.

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112. (new) The process of claim 70, wherein the microorganism has the ability to produce at least one rhamnolipid.